Electrospun Bio-composite Nanofibers for Bio-sensing
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Introduction:

A biosensor can be defined as a device that converts biological signal into an electrical output with the detection mechanism utilizing the biological system directly. Enzymes are nature's most specific and selective catalyst and many of them have been identified as precise bio recognition molecules applicable in the sensor field. The greatest obstacle preventing commercial production is the loss of enzyme activity in even slightly not biocompatible environment. Some of the stringent requirements to retain enzyme stability are pH values between 6 and 9, and absence of covalent interactions with the medium.

Urease E.C.3.5.1.5 acts as a catalyst in the hydrolysis of urea to ammonia and carbon dioxide: $CO(NH_2)_2 + H_20 \xrightarrow{UREASE} CO_2 + 2NH_3$. Urea is one of the main components of human urine, and waste product that builds up in the blood. Abnormal levels of urea in the blood and urine indicate liver function problems. Therefore it has found a wide range of applications in the medical field for detoxifying blood in kidney machines[1]. In this work we studied electrospun nanofibers of urease and polymer composite as an innovative urea biosensor material.

With the increasing demand for nanotechnology electrospinning has become a novel technique for generating composite nanofibers. In this process a polymer solution is injected from a small nozzle under the influence of an electric field as high as thirty kV/cm. The build up of electrostatic charges on the surface of a liquid droplet induces the formation of a jet, which is subsequently stretched to form a continuous fiber. Before the jet reaches the collecting screen the solvent evaporates or solidifies. The fibers are collected on a conductor surface, and form nonwoven mats that are characterized by high surface areas and relatively small pore sizes. This improves the adsorption properties and advances the sensitivity[2].

Results:

The enzyme-polymer solution was prepared by mixing 70% by volume of $4.615*10^{-5}$M polyvinylpyrrolidone (PVP) in ethanol solution, with 30% by volume urease solution with 1577.6units of urease dissolved in 10mL of .1M PBS buffer. Reactivity measurements were taken for five differently concentrated urea solutions using the Thermo Orion ammonia electrode with the urease/polymer solution before and after electrospinning. The increase in ammonia concentration for both the solution and electrospun fiber mats proved that the enzyme retained activity not only inside the polymer solution, but also through the electrospinning process.

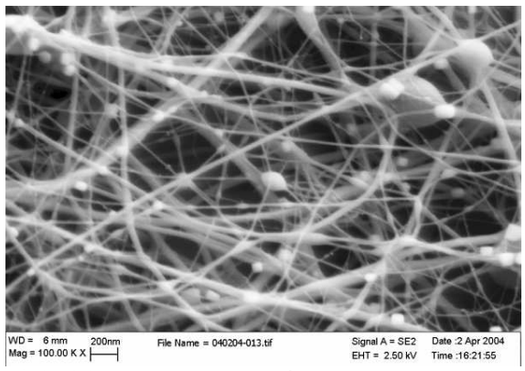
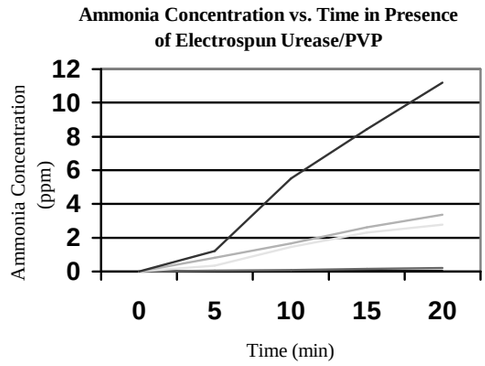


Fig1. Polymer-enzyme nanofibers.



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1.Qin Y, Cabral JMS "Properties and applications of urease", Biocatalysis and Biotransformation, vol 20, p1-14, 2002

2.Zheng-Ming Huang, Y.-Z. Zhang, M. Kotaki, S. Ramakrishna, "A review on polymer nanofibers by electrospinning and their applications in nanocomposites", Composite Sci. and Tech., vol 63, p.2223-2253, 2003